

IMPACT OF CD ROM ON INFORMATION SERVICES

INPUT

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ON INFORMATION SERVICES

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Impact of CD ROM on Information Services

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IMPACT OF CD ROM ON INFORMATION SERVICES

ABSTRACT

CD ROM represents an exciting breakthrough in storage technology with its ability to store 150,000 pages of information, two hours of sound, or the contents of 1,200 floppy disks. The impact that CD ROM will have on information services markets both as an opportunity (e.g., software and turnkey systems) and a potential revenue transfer (e.g., from computer output microfilm or on-line services) is the subject of this three volume multiclient study.

Volume I concentrates on providing an overview of the total CD ROM market, the principal applications, and the strategic opportunities that are available. It also offers a preliminary forecast of how fast CD ROM markets will grow.

Volume II examines user needs in detail with a survey of Fortune 1000 companies' plans and current CD ROM applications and a forecast of the development of these needs. Each application category is explored and forecast to 1991.

Volume III provides an analysis of CD ROM vendors and the current plans, products, and services of information services vendors to incorporate CD ROM into their services. Case studies of the most important players and/or partnerships are included.

This report contains 89 pages, including 33 exhibits.

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IMPACT OF CD ROM ON INFORMATION SERVICES

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I INTRODUCTION

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A. DEFINITION OF CD ROM

- During the late 1970s, videodisk systems came on the market, and in the early 1980s an optical videodisk system called Laservision emerged from vendors such as Reference Technology, Philips, and Pioneer. Sony and Philips pursued audio compact disks (CD), and recently the use of CD for digital data, text, and images was unveiled, although with no standard format as yet.
- Writable optical disks offer users a one-shot opportunity for permanent archival storage of large quantities of information. These WORM (write once, read many times) or DRAW (direct read after write) drives suffer currently from the fact that even though their best application is archival storage, the media does not last longer than 10 years.
- Compact Disk Ready Only Memory (CD ROM), unlike other storage media, is not affected by repeated reading, can be handled, scratched, left in direct sunlight, covered with dust, coffee, and other office environment hazards, mailed, scanned with airport security devices, and dropped with impunity. It uses the same disk mastering/replication/read technology as sold to compact disks (which should allow it to benefit from reductions in manufacturing costs for many of the common parts for the drives).

- CD ROM represents an exciting breakthrough in storage technology with its ability to store 150,000 pages of information in text format (or 15,000 images of the same data), two hours of sound recordings, the contents of 1,200 floppy disks, or over 500MB of digitized data. Other read only optical disks (that are not physically or logically compatible with CD ROM) include Sony's DataROM and 3M's OROM.
- The disk itself records data on a single, continuous, three-mile long track of PITS (indentations) and LANDS (spaces between indentations) at a track density of 16,000 tracks per inch or 160+ times the highest recording density of floppy disks. MASTERING (making an original of the data) costs between \$3,000 and \$10,000, and subsequent copies (depending on volume) range from \$5 to \$30 each. The transition from pit to land or land to pit represents a "channel 1" and the length of the land in between represents the number of "channel 0s." Each user byte (8 bits) is represented by a 17 channel bit. Twenty-four such symbols plus a sync pattern, a control and display symbol, and eight error correction symbols form a FRAME--the basic unit of CD ROM storage.
- To perceive the real potential of CD ROM, however, we must step into an application. Whereas mere storage capacity may excite, the ability (for example) to index every word and/or number in the text liberates the text from its customary immobility of being locked in one physical location and opens up new vistas: the user can extract, analyze, and combine data from the text body depending on his informational needs, rather than retrieve a camera copy of the raw, unprocessed text. This "Full Text Management" capability will surely revolutionize the way in which we distribute and process information in the same way that the personal computer did.

B. ADVANTAGES OF THE MEDIUM

- Compared to magnetic reading, optical reading has substantial, practical advantages.
 - Dirt, scratches, or other impurities are ignored because the laser beam has a steep convergence; as it passes through the protective lacquer of the surface of the disk it is a full 1mm wide, so the (relatively large) beam does not "see" the impurities.
 - Head crashes are highly unlikely: the CD ROM read head is 2,000 times further away than a Winchester disk head is from its sensitive recording media, and even if it touched it would be touching a protective lacquer--the same material used to make bulletproof windows.
 - Error correction is unparalleled: the error correction decoder placed on the disk along with the data can take raw data in which one bit in every 10,000 is wrong and reconstitute the original with a loss of one bit every quadrillion (or once every 500,000 CD ROMs of data).

C. INTERFACE

- Early drives were shipped with a variety of interfaces, but emerging trends are for the CD ROM to be furnished with intelligent rather than dumb interfaces such as SCSI or ESDI. One reason for this is to accomplish error correction prior to data transfer, but the options that are opened up by this move go far beyond.
 - Controlling I/O can be delegated by the CPU to the bus, freeing expensive mainframe cycles for other tasks.

- Up to eight devices (CPUs or peripherals) can share the bus and exchange electronic handshakes for data transfer to targets on a single initiator/single target, single initiator/multiple target, or multiple initiator/multiple target basis.
 - Intelligent buses can handle today's transfer rates and are not generally bandwidth bound; SCSI, for example, can handle 4MB per second at distances of up to 25 meters.
- The interface issue is not an abstract esoteric consideration; without an industry-wide resolution on it, many hardware suppliers will suffer considerably if they take the wrong turn (taking with them the unfortunate pioneering users who bought their systems), software suppliers will be unwilling to commit resources to the systems and applications software (which is vital to the development of the market), and users will not buy.
- With typical caution, IBM has not committed itself one way or the other and still retains the option of producing its own interface standard (which would set everybody back two years). Rumor has it that IBM will enter the CD ROM market in the fall of 1986 with an interactive, education-oriented system. If true, this would appear to be an unexciting choice of markets--until one considers the impact that CD ROM could have on IBM's magnetic storage business, at which point it appears extremely logical for IBM to stay away from any worthwhile CD ROM market until competition forces it to respond.

D. STUDY SCOPE

- This study is the first in a new series by INPUT designed to trace the impact of CD ROM on the information services industry. It will set the stage for two further studies on CD ROM:

- CD ROM User Applications, which will analyze the needs, attitudes and expectations of the first level of CD ROM users who will be targeted in the next two years.
- CD ROM Vendors and Services, which will deal with the information services vendor approaches to integrating CD ROM into their offerings and with the markets (size, growth and characteristics) that represent the best short- and long-term opportunities.
- This report covers the first products, the first applications, and the first vendor initiatives and provides a backdrop forecast of the impact that CD ROM will have on the information services industry. Forecasts in this report are "order-of-magnitude" forecasts that will be updated and expanded by the two volumes referred to above.

E. METHODOLOGY

- In 1983, INPUT conducted a study on the impending arrival of optical memory systems and concluded that information systems managers, as well as information services vendors, were largely unprepared for the fundamental changes that optical storage systems would bring to their environments. This continues to be the case. INPUT has drawn on its existing body of optical storage research and on interviews with 100 large corporations that were conducted in March of this year. In those interviews it became apparent that companies could be divided into three tiers:
 - Those that are actively pursuing the application of optical storage to their needs and are currently engaged in prototyping new products.

- Those that have learned that their competitors are implementing the new technology, are wondering what they should be doing themselves, but don't yet have a plan.
 - Those that do not see the need to even investigate the possibilities and are "sure" that optical storage does not affect them.
- This report will hopefully convert all of those in category 3s into at least category 2s and will provide helpful guidance to those already in categories 1 and 2.
- As usual, INPUT welcomes your comments, queries, and suggestions.

II EXECUTIVE SUMMARY

II EXECUTIVE SUMMARY

- This Executive Summary is designed to help the busy reader quickly review the research findings of this report without having to delve into each section. Each of the key points is summarized as an exhibit with an accompanying script on the left-hand page. This format is designed to facilitate use of the Executive Summary as an in-house overhead presentation.
- The use of CD ROM in existing markets and applications is the highest potential for CD ROM in the near term; this is why INPUT has concentrated on the impact of CD ROM on Information Services. CD ROM eventually will create new markets of its own, but this phase of development will not be significant in revenue earning potential for at least five years.
- CD ROM is already being challenged in the laboratory (though not yet in the marketplace) by derivative technologies that overcome some of CD ROM's shortcomings. For example, WORM (write once, read many times) and DRAW (direct read after write), not to mention fully erasable optical disks are all practical realities. However, CD ROM offers tangible advantages over these products and represents a quantum leap forward in distributed storage systems.

A. CD ROM: "VIDEOTEXT" OR "PC" MARKET?

- The main CD ROM issue facing vendors and end users alike is whether to take CD ROM seriously or whether it will be another "videotext" type market--a great idea that is always about to happen. INPUT believes that a better comparison would be with the PC market (see Exhibit II-1).
- In 1980 it was very hard for many vendors and users to believe that micro-computers--as the PC was known then--would have a serious effect on the corporate environment, individual professionals, minicomputers, mainframes, or any other environment. By 1983 everyone was having to tell their management what plans they had for using the PC, and by 1985 it was difficult to find a market or environment not impacted.
- CD ROM does to storage what the PC did to processing: it personalizes information availability and reduces the cost of access to large data bases to the point where new ways of information handling and usage become possible. Also similar to the PC market development, CD ROM is a software-dependent, software-driven market; without adequate, specific software tools, the product's value is diminished substantially.
- INPUT believes that CD ROM will follow in the footsteps of the PC in terms of making possible personal, distributed storage systems in the same way that the PC made personal distributed processing a reality.

INPUT®

CD ROM: "VIDEOTEXT" OR "PC" MARKET?

"VIDEOTEX-Like"

- War among Vendors for Standards
- A "Revolution" still waiting to happen

OR

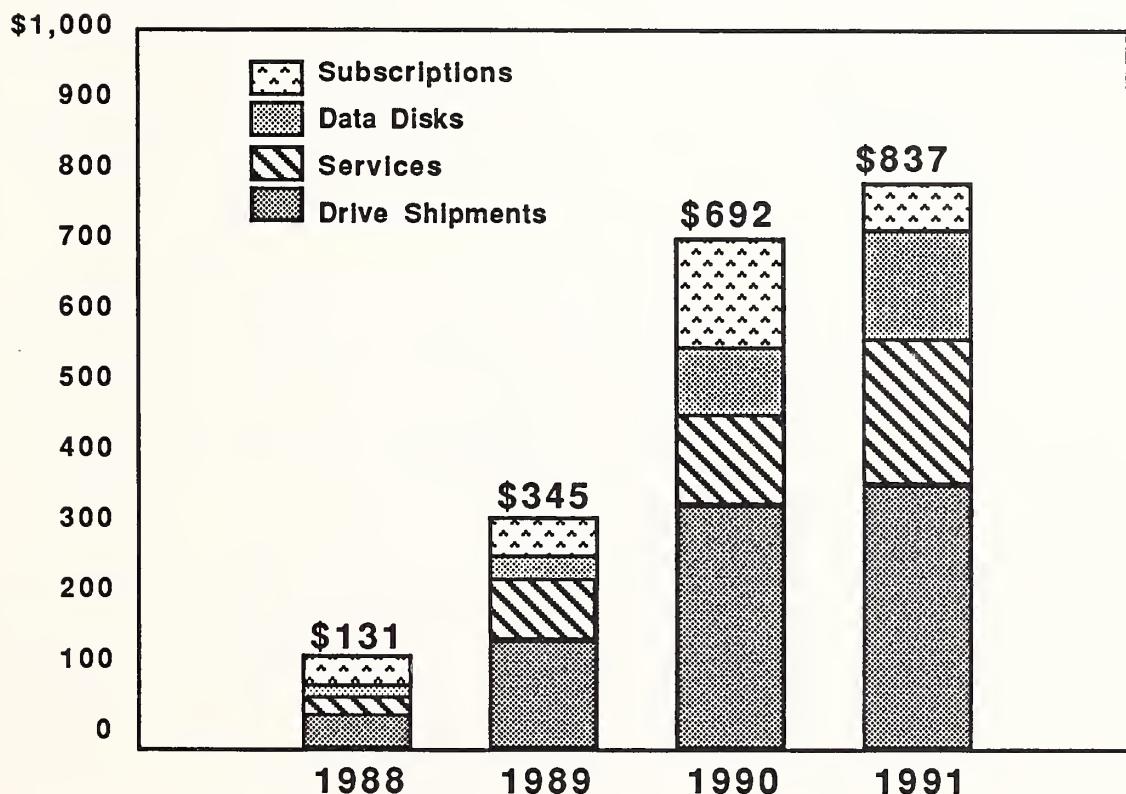
"PC-Like"

- Personalization of Storage
- Software-Driven
- Explosion of Dealers, Vendors, and Products

B. PERSONAL COMPUTER-RELATED CD ROM MARKETS

- The initial launch of CD ROM will owe much to the rate at which it can penetrate the PC market. The combination of a personal processing tool (PC) with personal archival/reference storage (CD ROM) is very attractive.
- Unlike any of the other PC storage media, CD ROM can support large volumes of images, data, text, and voice with on-line retrieval of all four at access speeds of one second. Currently, this capability is limited to read only. The possibility of accessing 500MB of prerecorded information on specialized topics raises substantial opportunities in education, taxation, accounting, legal, government, insurance, health care, and many other application areas.
- Exploiting these opportunities is a vast, untapped challenge to software vendors and multimedia specialists. It also requires close collaboration between application-knowledgeable experts (e.g., tax accountant), system designers, and software specialists. CD ROM pushes the need for this type of cooperation down to the third level of the SIC code markets.
- The forecast for CD ROM hardware, mastering services, subscriptions, and disks is provided in Exhibit II-2. Over the next two years the market will be small (less than \$30 million) because of the lead time to develop adequate software, but by 1988 a rapid expansion very similar to the early development of the personal computer market will begin: rapid growth, influx of vendors, proliferation of software vendors, drive to "capture" the distribution channels (dealers, distribution), and concentration on consumer and retail markets to achieve volume expansion.

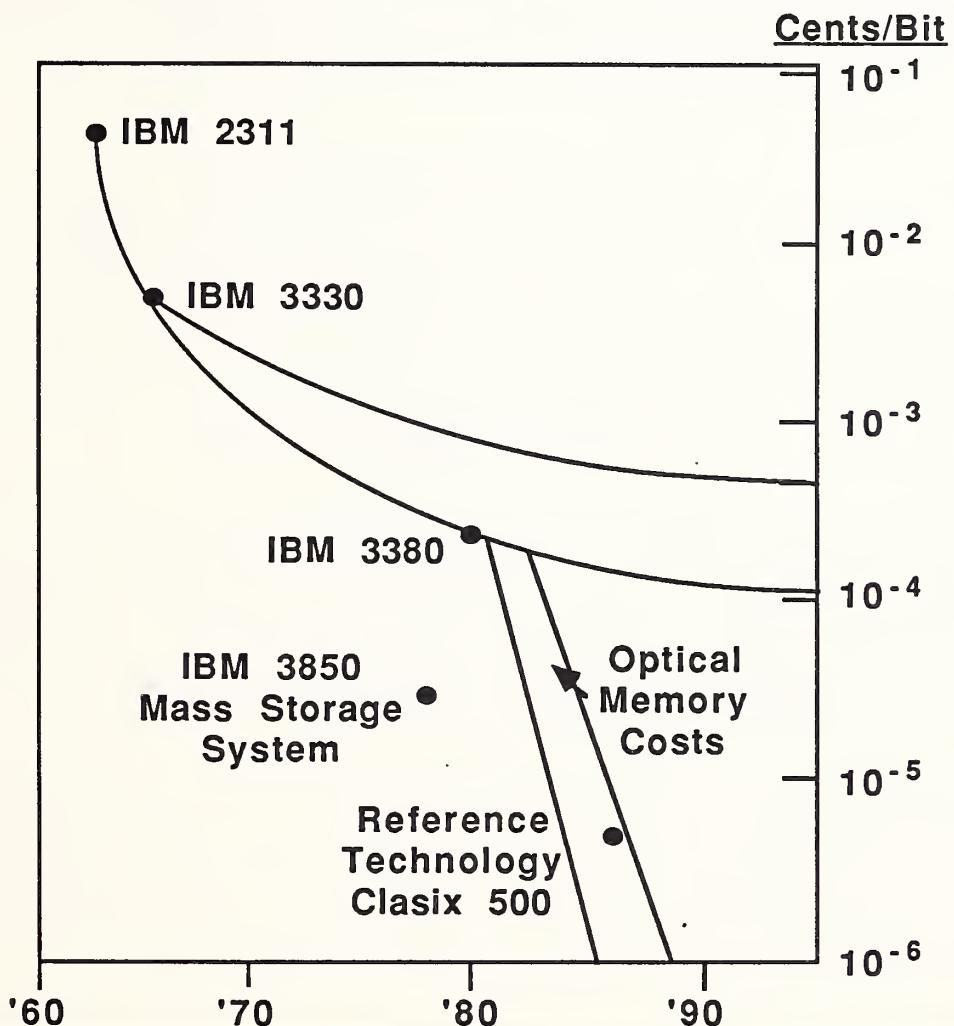
CD ROM MARKETS, 1986-1991



C. CD ROM STORAGE COSTS ON TRACK

- In 1983, INPUT published its study "Impact of Upcoming Optical Memory Systems". In that study a forecast of comparative storage costs was given for both magnetic and optical disk storage (see Exhibit II-3).
- That forecast is turning out to be accurate not only in the relationship of optical to magnetic storage costs but also in regard to the speed with which optical storage costs are falling. By the end of the decade, optical storage will not only be overwhelmingly cheaper than magnetic disk, but will also have a measure of read/write capability (which is the biggest drawback of CD ROM at present).
- Optical storage is also already cheaper than paper files and computer output microfilm, and the disparity in the cost will grow rapidly. It is most appropriate to compare CD ROM with paper and COM because the three media share the same fundamental characteristic: read only after file creation.
- By the end of the decade, CD ROM will be 100 times cheaper than both paper and COM for per-bit storage, with the added attractions of faster access time, portability, content indexing, and resistance to degradation. COM will be most vulnerable as installed equipment reaches replacement time; paper files will continue because of the users' familiarity with them.

OPTICAL VERSUS MAGNETIC DISK STORAGE COSTS, 1960-2000



D. BARRIERS TO MARKET PENETRATION

- Many barriers to CD ROM's unbridled use exist:
 - Start-up costs are high: not only is the conversion and formatting of large volumes of information time consuming and costly, but the information must be carefully edited for errors (those that exist in the body of information already or those that are created in the conversion process) before "freezing" its status for CD ROM duplication.
 - CD ROM drives are not cheap (currently \$500 in volume), and a minimum installed base of drives is necessary if CD ROM disks are to read an acceptable share of the customer base; in addition, hardware standards have not been agreed on (let alone software standards) so that large hardware investments could be at risk.
 - The best short-term CD ROM applications are those that apply user-profile specific information access tools to vertical market-specific information; unfortunately, creating the right kind of "intelligent" menus to access such information files is a slow process.
 - The best long-term CD ROM applications will involve multimedia skills--combining CD ROM's audio and visual storage capabilities as well as plain text/data storage capabilities; this is a relatively new discipline, lacking a pool of multimedia skilled specialists.

BARRIERS TO MARKET PENETRATION

- **Lack of Standards**
 - **Hardware**
 - **Software**
- **Start-up Costs Are High**
 - **CD ROM is Expensive**
 - **Data File Creation is Expensive**
- **User-Specific Interfaces Needed**

E. NET IMPACT OF CD ROM ON INFORMATION SERVICES

- CD ROM offers new, exciting markets for information services vendors with very little negative impact on existing services. Current opportunities are small and commercial contacts few and far between. However, the present education/research/scientific markets represent sizeable prototype service opportunities that should be viewed from a long-term, strategic value standpoint--they will quickly mushroom over the next five years.
- Some negative impact will be felt by 1991 on processing/network services, principally on archival search, historical reference services, and gradually increasing to include on-line data base search services where the data is three months or more old. Hybrid services (where CD ROM-based search is combined with real time RCS search) will add new services, however, with a net positive impact of over \$400 million in 1991.
- Software products, turnkey systems, and professional services will be only positively impacted. CD ROM-based turnkey systems will of course be the prime market, expected to generate \$800 million by 1991 with CD ROM software products (systems and applications) producing over \$600 million in the same year.

Exhibit II-5 shows the combined CD ROM information services picture--a \$2.1 billion opportunity by 1991.

NET IMPACT OF CD ROM ON INFORMATION SERVICES

SERVICE DELIVERY MODE	NET IMPACT (\$ M)	
	1986	1991
Processing/Network Services	*	\$425
Software Products	*	610
Turnkey Systems	*	800
Professional Services	*	265
Total	(Small)	\$2100

F. UNDERSTANDING CD ROM APPLICATIONS

- To isolate CD ROM application opportunities, a number of criteria can be applied that pertain to existing characteristics of the information to be processed as well as potential characteristics not currently made use of
- The first is that the application must be largely dependent on the content (quality, accuracy, and specificity) of the information and its comprehensiveness. Generally speaking, any complete body of information that is less than 20MB in size would probably not be suitable
- Secondly, the application should not be time-sensitive (most CD ROM-based information will be three months or more old), otherwise another access and storage method will be more appropriate. CD ROM may, of course, coexist with real time access capabilities such as timesharing or on-line, in-house mainframe services. Such "hybrid" systems, using perhaps the PC as a distributed processing mode to a mainframe or timesharing source as well as the CPU for driving a CD ROM reference file, would be effective.
- Thirdly, and perhaps most importantly, the application must depend on an on-going "need to know" of a large body of similar uses. This requires that the user interface be very user-profile sensitive (i.e., be directed at a specific professional, informational requirement and offer several levels of capabilities, depending on the knowledge level or proficiency of the user).

UNDERSTANDING CD ROM APPLICATIONS

- **Data Content Dependent**
- **Not Time-Sensitive**
- **Large Audience**
 - **Focused Groups of Professionals**
 - **Narrow Functionality**

G. PRE-RETRIEVAL, POST-RETRIEVAL, AND WAYFINDING

- The success of a CD ROM application relies on three software-dependent capabilities:
 - Pre-Retrieval: Includes indexing the entire data base in a way that will optionally support retrieval of information (which is dependent on the type of application), knowing what questions are likely to be asked of the data base, and accurately transforming such reports into queries that are understandable to the operating system.
 - Post-Retrieval: Includes the application-specific processing of the retrieved information, interactive interface with the retrieval process, and interactive interface with a specific user type.
 - Wayfinding: Helping the user "navigate" in the sea of CD ROM information they have on-line (moving from one level of query to another, retracing their steps, getting help about what steps to take next, decision prompting etc).
- This is the "suiting up" process--speaking in terms, presenting options that are specific to the needs and thought process of a specific profile of end user (e.g., attorney, tax accountant, medical practitioner, librarian, etc). Limited quantities of software exist with these capabilities at present, presenting software vendors with extraordinary opportunities.

PRE-RETRIEVAL, POST RETRIEVAL, AND WAYFINDING

- **Intelligent Indexing**
- **Application-Specific Processing**
- **Navigating**

H. CD ROM--A MARKETING AND COMMUNICATIONS TOOL

- CD ROM presents other, exciting opportunities which on their own justify taking a close look at the medium: it offers new ways of handling old problems. Two examples are given below, the first using CD ROM as a communications tool, the second as a marketing tool.
- First, a large information-based corporation's communications with its operating divisions typically do not distinguish between the varying life cycles of the information processed; a query on today's prices or inventories is handled in real time as is a query on the customer base. This mixes volatile data with semipermanent data indiscriminately and processes them both on-line. Volume queries typically lead to the "need" for mainframes, front-end processors, and many high yield lines. A CD ROM, on the other hand, provides unlimited access to all semipermanent information for around \$10 a person and provides a means of carefully controlling what information is released.
- Second, drug manufacturers spend \$20,000 per year on each of the 175,000 physicians who write prescriptions telling them about their new products. This is an expenditure of \$3.5 billion per year. Very little of this information actually gets to the physician, who typically employs someone to screen him from all of the literature, mail, and sales visits he would otherwise be subjected to. He is also required to read at least some of the 4,500 medical journals published each year to stay current. A periodic CD ROM disk delivery containing all of the such information would save him time, allow him to electronically search for useful data, and save the medical journals/drug manufacturers millions in wasted effort.

CD ROM - A MARKETING AND COMMUNICATIONS TOOL

Marketing

- **Cut Costs**
- **Improve Information Distribution**

Communications

- **Unlimited Access to Semipermanent Information, Data and Text**
- **Off-Load Mainframe Real Time Queries**

III MARKET ANALYSIS AND PRELIMINARY FORECASTS

III MARKET ANALYSIS AND PRELIMINARY FORECASTS

A. OVERVIEW

- Before analyzing the impact of CD ROM on information service markets, a brief overview of the various CD ROM markets is necessary. Currently the technology, standards, and vendor support given to CD ROM are changing very rapidly--from minor to major--and will evolve even faster over the next three years
- INPUT's assumptions on the key market developments in 1986, 1987, and 1988 are listed in Exhibit III-1. IBM's involvement with CD ROM, INPUT believes, will begin with the announcement of an interactive/educational, CD ROM-based system. This will strike at the heart of Apple's PC base. Apple itself announced June 3, 1986, that it had begun a joint research project with the National Geographic Society and Lucasfilm, a movie maker.
- Education will be a prime market target for many reasons:
 - The data used in over 90% of the educational process is archival/reference data.
 - Multimedia educational processes are very effective, and all four types (audio, image, text/data, and interactive processing/feedback) can be stored/supported by CD ROM on a single disk.

EXHIBIT III-1

**CD ROM MARKET ASSUMPTIONS:
THE EARLY YEARS**

- 1986 : Volume production of CD ROM drives begins
- : IBM announces Interactive Educational CD ROM system
- : First significant commercial installations
- 1987 : Microsoft and others announce CD ROM software drivers as extensions to PC DOS
- : Vertical market applications software packages take off
- : CD ROM drive price under \$500
- : Vendors rush to sign up dealer/distributor agreements
- 1988 : CD ROM hardware standards finalized
- : "De Facto" O/S driver standards emerge
- : CD ROM "publishing" appears in retail stores
- : IBM announces open-ended CD ROM products
- : CD ROM drives under \$450

- It is a good test market for prototype products since the end users are more tolerant than commercial users of any shortcomings while at the same time being more perceptive of the possible uses and applications to which the product can be put.

B. CD ROM MARKETS

- A thumbnail analysis of CD ROM markets quickly reveals that it is very similar to the record industry:
 - The cost of the "consumable" (CD ROM disk) is orders of magnitude less than the means of using it (CD ROM drive)
 - The market for the consumable is directly proportional to the installed base of drives.
 - CD ROM services (i.e., the means of producing and copying the consumable) will be a substantial business in its own right.
 - The distribution of the consumable (disk) will require a substantial network of specialty retail stores for generic data disks and a direct sales force for specialty data subscriptions.
 - The total value of consumables and services will easily exceed the value of the drive markets in the early years.
- The initial thrust supporting the development of the CD ROM markets will be the personal computer, which CD ROM enhances in many ways. The main attraction is that a vast array of new applications can be tried with the PC without the need for huge investment a mainframe-driven product would need.

- A conservative, PC-related market forecast of the average CD ROM unit price, shipment volume, and installed base is presented in Exhibit III-2. Also provided are the forecasts for the services (e.g., mastering of data disks and prototype testing of customized systems) and the disks themselves (consumables).
- While the 1986 markets are extremely modest in size, the 1988-1991 period will show very rapid development of all three of the main hardware-related markets:
 - CD ROM drive shipments: Valued at between \$600 and \$380 per unit, including the interface, drive shipments are expected to approach one million units by 1991, valued at a third of a billion dollars.
 - CD ROM Services: Principally the mastering and distribution services associated with the preparation of the CD ROM disks and the conversion of the data files carried, this market is expected to read \$200 million by 1991.
 - CD ROM Disks: The volume of disks expected to be shipped over the forecast period is truly staggering. Based on the assumption that an average of CD ROM drive will use between 2 (1986) and 10 (1991) disks per year due either to updates of the same information set or copies of different information sets. By 1989, the market is expected reach over 3 million disks annually and to exceed 22 million per year by 1991.
- Obviously, the PC is not the only market that CD ROM can serve. Mini-computers, particularly superminis, can be substantially enhanced by CD ROM. A bank of eight CD ROMs can now be connected to a single parallel port providing 4 gigabytes of on-line storage for less than \$15,000 with a one second access. This easily competes with an IBM 303X with a 3850 mass storage system (with 16 second access).

EXHIBIT III-2

PERSONAL COMPUTER-RELATED
CD ROM MARKETS, 1986-1991

	1986	1987	1988	1989	1990	1991
<u>Drive Shipments</u>						
Average Price	600	500	450	420	400	380
Units (K)	5	40	120	360	750	950
Sales (\$ M)	3	20	54	151	300	361
<u>Installations (M)</u>						
CD ROMs	0.01	0.05	0.17	0.53	1.28	2.23
PCs	11.50	14.20	16.60	18.70	20.70	23.00
<u>Services (\$ M)</u>						
Production/ Copying	3	8	25	75	150	200
<u>Data Disks</u>						
Price (\$)	15	12	10	9	8	7
Disks/Drive/Yr.	2	3	4	6	8	10
Shipped-K	10	135	660	3150	10200	22250
Sales (\$ M)	0	2	7	28	82	156
<u>Subscriptions</u>	1.1	15	45	30	160	220

- Exhibits III-3 and III-4 show the forecasted size of the hardware-related markets in 1987 and 1991.

C. CD ROM SOFTWARE MARKETS

- The market development for CD ROM software is a close interaction of hardware sales, systems software availability, and identification by vendors of CD ROM applications markets. In many ways this will be a replay of the personal computer market, where hardware sales were small initially because there were no standard operating systems or applications packages which could facilitate their use. Once software vendors become convinced that the market potential was, to all intents and purposes, limitless, software proliferated. In other words, it was more the conviction that the market was there that launched the PC software industry than proven reality. So it will be with CD ROM software--as soon as vendors become convinced there is a market opportunity, they will develop the software, which in turn will develop the market.
- Forecasting the development of the CD ROM software market is thus a subjective matter, but we can rely on certain reasonably sure assumptions, allied with estimates of how far and how fast the CD ROM vendors will go. To the extent possible, systems and applications software products markets have been separated. It is not possible to ascertain which part of these markets each (different) CD ROM hardware type will capture. Currently the hardware standard battle has not been won, and IBM has yet to declare itself.

I. CD ROM SOFTWARE PRICING

- CD ROM software pricing is an untouched subject: It is likely that CD ROM software packages will be bundled with the information and sold on a subscription basis. (This would eliminate the need for software licensing.)

EXHIBIT III-3

PERSONAL COMPUTER CD ROM MARKETS, 1987

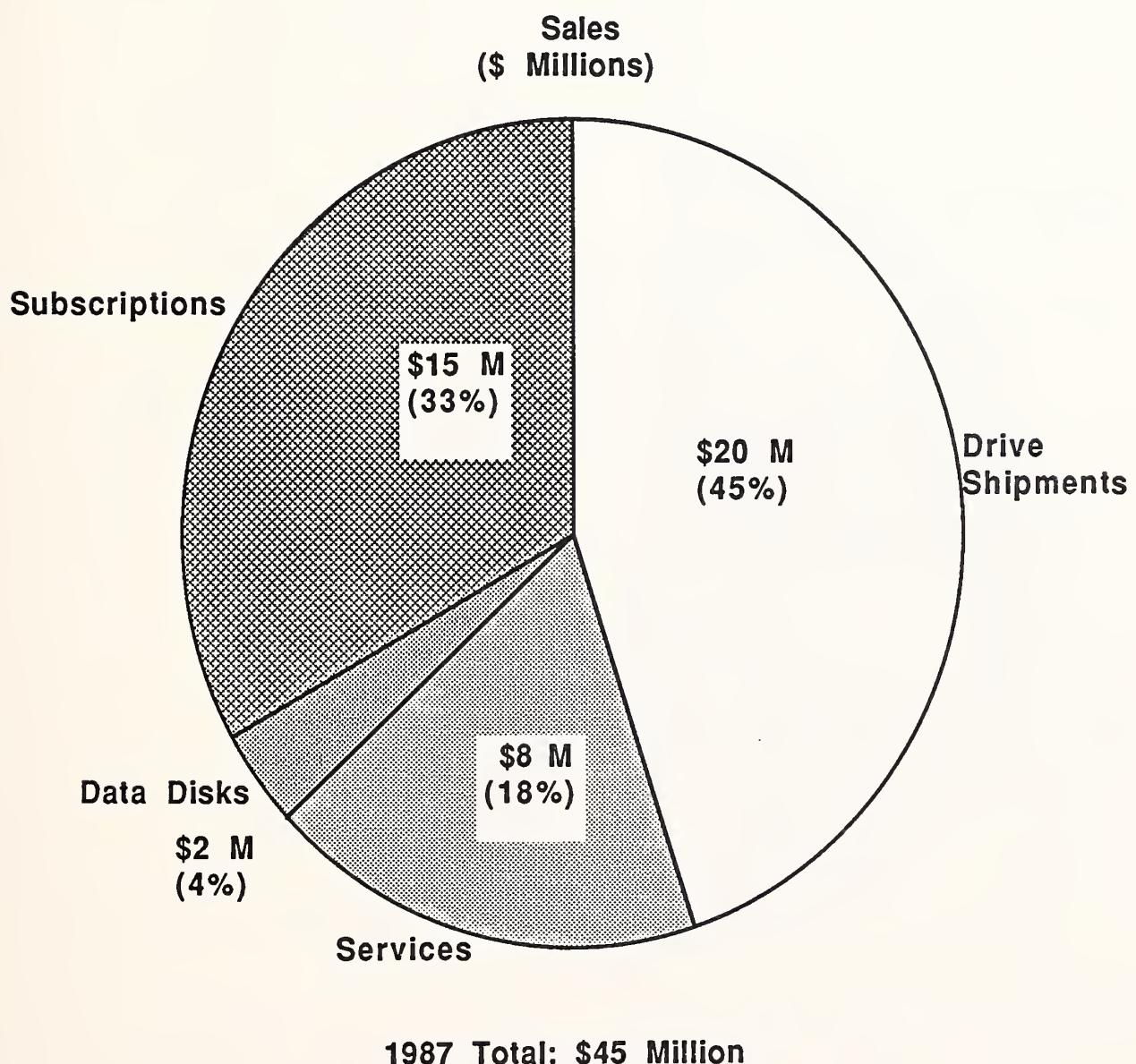
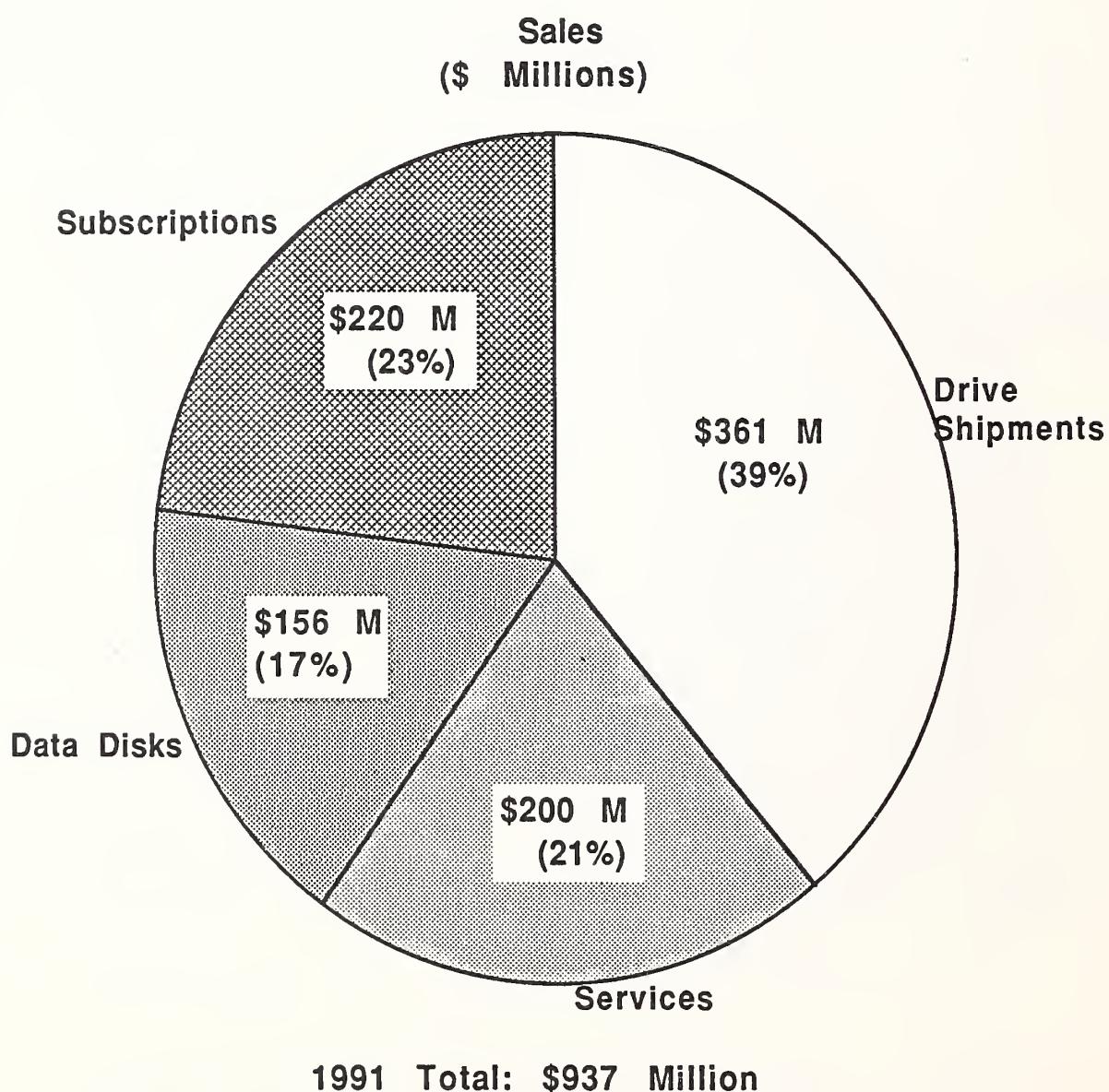


EXHIBIT III-4

PERSONAL COMPUTER CD ROM MARKETS, 1991



- Exhibit III-5 shows the CD ROM software pricing options open to software vendors.
 - Bundled with information: This option allows the software vendor to control the release of software updates along with the release of information updates while including the software lease price in the information lease; additional safeguards that can be built in include making the software functional only for the specific format of data/information contained on the CD ROM disk. Other pricing options include "value-in-use" pricing--i.e., increasing the revenue received for the lease of software and information based on its value to the end-user.
 - Bundled with CD ROM storage unit and interface: This option applies to one-time packages of CD ROM drive software and information used for archival/reference search, particularly library or educational reference-type applications (e.g., Brown University's ISOCRATES product which placed all Greek texts prior to AD700 on a CD ROM); this option allows a one-time package price or life-time lease of the CD ROM drive, interface, software drives, and information disk.
 - Conventional pricing options: These include the traditional bundled turnkey system approach and the unbundled pricing of systems and applications software; the latter option lays the software vendor open to the usual abuses of market downturns, competitive thrusts, and the usual administrative costs of invoicing of collection.

2. CD ROM SOFTWARE PRODUCTS

- The impact of CD ROM on the software market will be to add a whole new dimension of opportunities and needs. It is essential to the development of the CD ROM markets that standard drives for the disk drives become

CD ROM SOFTWARE PRICING OPTIONS

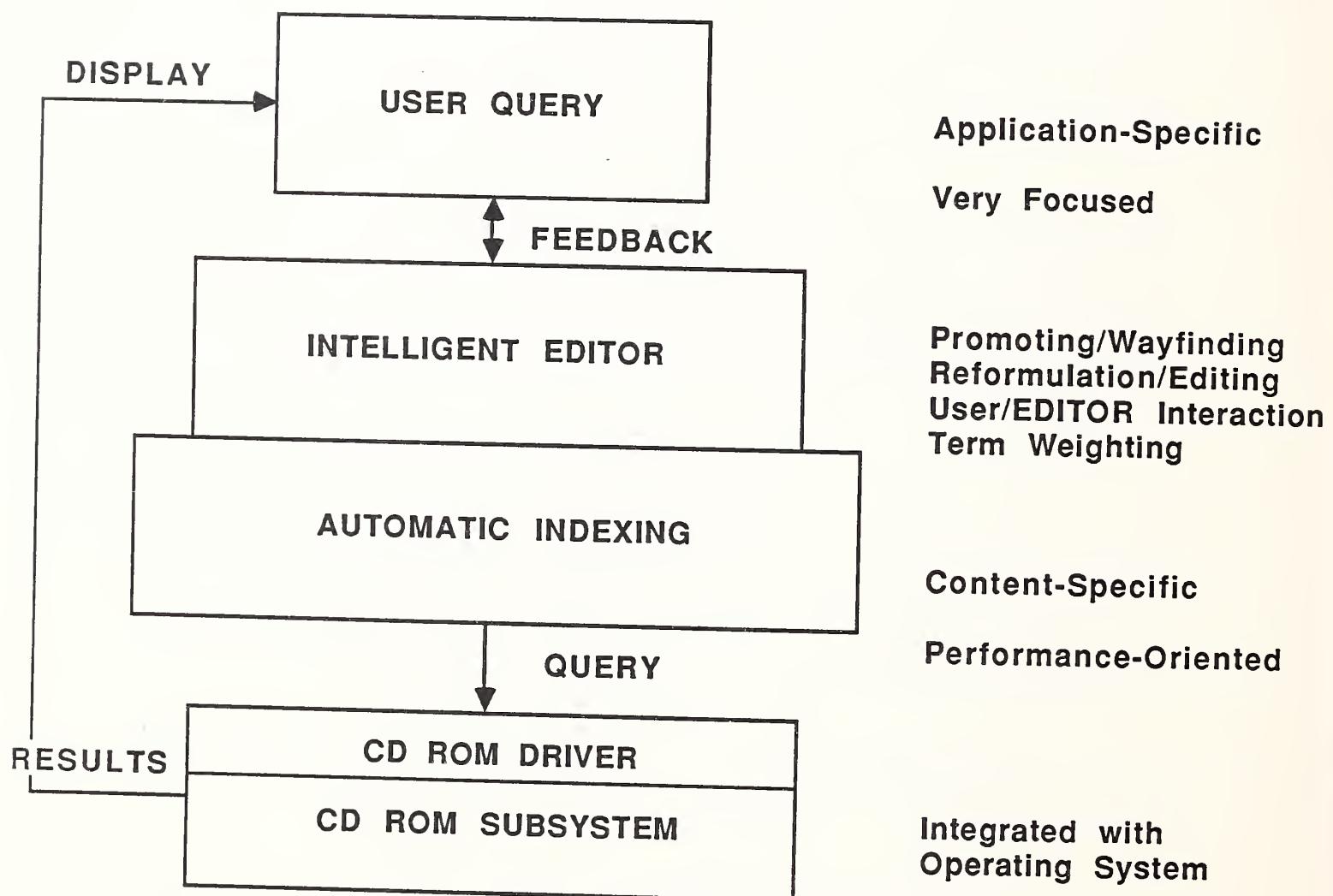
- **Bundled with Data/Information**
 - **Value-in-Use Pricing**
 - **Unique to Data/Information Format**
 - **Leased with Data/Information**
 - **Updates Released with Data/Information**
- **Bundled with Storage Unit/Interface**
 - **One-Time Package Price**
 - **Lifetime Lease**
 - **Support Separate**
- **Bundled with System**
 - **Rent/Lease/Buy**
 - **Support Bundled with System Maintenance**
- **Unbundled**

available quickly. Currently, the hardware manufacturers have been providing their own, but software vendors may choose to develop new drives, particularly in view of the huge variety of indexing options for the information contained on each CD ROM disk.

- Like many early-stage markets, each new CD ROM application may rely on unique software designed specifically for its needs (in the absence of off-the-shelf alternatives). Ultimately, standard software devices will become desirable, particularly if they exploit high performance, proprietary indexing systems. Indeed the whole area of retrieval research must now offer practical solutions to not only data or text processing/retrieval but also for image and sound retrieval (and integrate them where possible).
- This, then, is the challenge that CD ROM presents to software vendors--to go beyond straight hardware operation and offer a range of data/information/image/sound handling routines that account not just for the structure of the recorded material (as in today's DBMS) but for the indexed content of the recorded material.
- Much of the research in Information Retrieval (IR) has centered on four options: the Boolean model, Vector/probabilistic, browsing, and artificial intelligence. In CD ROM browsing is very attractive, particularly if the software can intelligently edit/compliment the search query (e.g., provide synonyms and truncations and insert Boolean operations).
- Exhibit III-6 provides the global structure of a CD ROM retrieval system. The diversity of systems software opportunities lies in the fact that:
 - The Intelligent Editor must be tailored to not only the type of material (data, text, image, voice) recorded and how it is indexed, but also to the knowledge level of the user making the query.

EXHIBIT III-6

CD ROM SYSTEMS SOFTWARE MARKETS



- The edited query must be formulated in a way that is acceptable to the format of the recorded material.
 - The indexing of both data and query must be done to maximize two conflicting things: content specificity and search/retrieval performance.
- This is of course the traditional dilemma of systems software vendors--making a generalized system capable of handling as many varied and disparate cases as possible without sacrificing performance or overhead too much. CD ROM systems software opportunities go beyond this traditional dilemma by requiring that an intimate knowledge of the user and the data content be an integral part of the design and performance of the systems software package.
- Without application-specific content, the software will be noncompetitive (and not very interesting); with the application-specific content, the software will have a narrow market--which will raise the question as to whether it is worth developing in the first place.

3. IMPACT OF CD ROM ON SOFTWARE PRODUCTS

- Exhibit III-7 provides INPUT's estimate of CD ROM's impact on software products through 1991.
- CD ROM's impact on the software products market is entirely positive since it does nothing but add new market opportunities both in upgrading existing software and in opening up new product markets.
- The largest opportunity lies with microcomputers, where 5% of all software products sold in 1991 will need to be capable of handling CD ROM storage. Opportunities in the mainframe area are much smaller, but the minicomputer market will require software capable of driving CD ROM. Nevertheless, only 1% of mainframe minicomputer software will be CD ROM oriented.

EXHIBIT III-7

CD ROM's IMPACT ON SOFTWARE PRODUCTS

SOFTWARE MARKET	\$ MILLIONS		AAGR
	1986	1991	
Mainframe/Minicomputer Software			
Industry-Specific	3637	11895	27%
Cross-Industry	2888	6770	19%
CD ROM (additions)	*	185	N/A
Microcomputer Software			
Industry-Specific	702	4095	42%
Cross-Industry	1868	4415	19%
CD ROM (additions)	*	425	N/A
Total CD ROM (additions)	*	610	N/A
Total Software Products	9095	27175	24%
Total New Market	9095	27785	25%

* = Less than \$5 Million

- The net effect of these new CD ROM opportunities is to increase the 1991 software products markets by \$610 million--a significant development which should capture the attention of software vendors, because CD ROM will be the first in a long line of new optical storage devices which will gradually penetrate magnetic storage markets over the next ten years.
- The true potential of these optical storage device markets in software product terms is enormous. By 1995 (well into the market expansion phase of optical storage), the software product opportunities could easily expand to five times the size shown above for CD ROM alone. If this were to occur, a market opportunity of over \$3 billion would be available.

D. CD ROM'S IMPACT ON TURNKEY SYSTEMS

- The largest single CD ROM opportunity in the Information Services market is in turnkey systems, largely with customized combinations of applications and systems software driving tailored CD ROM.
- Two types of CD ROM turnkey systems will emerge:
 - CD ROM upgrades of existing systems, where the capabilities of CD ROM storage are added to systems that already have a market.
 - New CD ROM-based systems, designed from scratch to take advantage of opportunities arising from having large pre-recorded archival data bases on-site.
- The easiest to implement are the CD-ROM upgraded systems; however, since the architecture of the system being upgraded stays relatively unchanged, this is a poor way to implement CD ROM (albeit the quickest). Nor does it exploit

the full capabilities of CD ROM since the data management/content processing aspect of CD ROM must form the core of the systems design.

- Ultimately, new CD ROM turnkey systems are the only way to go, focusing on very narrow markets with user interfaces designed for narrow subsets of the professional and consumer populations. The majority of CD ROM turnkey systems will be sold to professional/commercial markets in the early years, progressing to consumer markets when CD ROM drive prices drop to around \$350 and when CD ROM disk libraries are available to maximize their usefulness. This is the exact opposite of the PC market evolution.
- While most of the first CD ROM turnkey systems are not selling millions of dollars of equipment yet, most have been in development for over two years. Most are still in the prototype evaluation stage, but by the same token have progressed beyond the laboratory out into the commercial marketplace.
- Examples are:
 - The multitude of library systems entered on the CD ROM storage of large bodies of reference material (these include the Library of Congress Cataloging Records, LC MARC, and many encyclopedia and dictionary products such as the American Encyclopedia and the Oxford English Dictionary).
 - The growing body of medical systems that are aimed at single functions of one discipline of the practicing medical professional (for example, the POISINDEX, an emergency poison identification and management information system, and EMERGINDEX, a critical care medical information system).
 - The combined census, marketing, and geographic data of National Decision Systems offers market researchers unlimited access to census data--something that neither in-house use (on mainframes with magnetic tape) nor on-line use can offer because of the cost factor.

- Yet there is a whole new spectrum of turnkey systems that holds even greater potential. These are the so-called multimedia turnkey systems which combine CD ROM's ability to store sound, pictures, and text as well as data. This is a new dimension of information processing and has already been successfully prototyped by Microsoft in their CD ROM-based encyclopedia that includes pop-up references in the main text, diagrams, illustrations, and sound commentary.
- The potential for all areas of reference-oriented applications is enormous when these multimedia storage capabilities are applied, but none so more than in education. The challenge to turnkey systems vendors is substantial, however, namely to expand their design, programming, and integration skills to sound, graphics, and text processing as well as to more common data processing.
- Exhibit III-8 shows the projected forecasts for turnkey systems to 1991 and the additions that CD ROM will make to the sales in that year. These are estimated as \$600 million for new CD ROM-based systems and \$200 million for CD ROM-upgraded systems. This corresponds to 24,000 systems and 8,000 systems respectively sold in that year.
- To be successful in the CD ROM marketplace, turnkey vendors must do one of two things (or both).
 - Establish a CD ROM division to explore multimedia possibilities in the markets currently served and to examine the potential of new markets not currently served.
 - Be ready to acquire successful startups who establish a foothold in vertical markets that have strategic relevance to the turnkey system vendor.

EXHIBIT III-8

CD ROM'S IMPACT ON TURNKEY SYSTEMS

TURNKEY MARKET	\$ MILLIONS		AAGR
	1986	1991	
Industry-Specific	6017	14920	20%
Cross-Industry	2653	5380	15%
Subtotal	8670	20300	19%
CD ROM Updates	*	200	N/A
New CD ROM-Based Systems	*	600	N/A
Subtotal	*	800	N/A
Total New Market	8670	21100	20%

* = Less than \$5 Million

- In all likelihood, however, the majority of CD ROM turnkey vendors who are successful in the early years will be newcomers to the business.

E. IMPACT OF CD ROM ON PROCESSING/NETWORK SERVICES

- The only area of Information Services that will be negatively impacted will be the processing/network services area. This impact will be confined to two activities.
 - On-line data base services that are based on reference or historical data (an example is the LEXIS case law data base from Mead Data Central).
 - Computer Output Microfilm (COM) and microfiche.
- In neither of these two areas will CD ROM have more than a peripheral impact, but it can be expected to have a serious effect on individual products. (The vendors of such products may be persuaded that CD ROM is the wave of the future and convert/upgrade their offerings to CD ROM as a matter of course, in which event the impact will be total).
- Exhibit III-9 shows the forecasted impact of CD ROM on processing/network services:
 - By 1991, less than 1% of on-line data base services will be lost to CD ROM conversions or \$60 million (equivalent to less than 0.2% of network/RCS/batch services), but \$40 million of COM services are expected to be converted to CD ROM in the same year.
 - On the other hand, new on-line business, generated as a result of the implementation of hybrid services (where on-line service compliments

EXHIBIT III-9

CD ROM'S IMPACT ON PROCESSING/NETWORK SERVICES

PROCESSING/NETWORK SERVICES MARKET	\$ MILLIONS		AAGR
	1986	1991	
Remote/Batch Computing	16854	35025	16%
(-) Business Transferred to CD ROM	*	100	N/A
(+) New Business due to CD ROM	*	525	N/A
Net (Increase)	*	425	N/A
Facilities Management (No Visible CD ROM effect)	2731	5520	15%
Other (VANS)	467	1600	28%
Total New Market	20052	42570	16%

* = Less than \$5 Million

archival, off-line service provided by a PC supported with CD-ROM), is expected to easily off-set the negative impact.

- No impact is expected, either positive or negative, on facilities management or value added network services.
- The net impact of CD ROM on the vast market of processing/network services is therefore quite small in 1991, but its total impact in the coming years may be substantial.
 - Turnaround time in the creation of CD ROM disks with recent information will drop from today's three months to close to one month by 1995; this dramatically shortens the advantage that on-line data base services have over current CD ROM systems.
 - Other optical storage options will be entering the market in force by 1991, including WORM (write once, read many times), that will further reduce on-line storage advantage over optical storage and introduce new markets of their own (e.g., file back-up)
 - Cost advantages, already in favor of CD ROM when considered from the angle of how much it costs to retrieve and display 100 records, will continue to increase in favor of CD ROM and become overwhelming in all reference/historic look-up types of applications.

F. IMPACT OF CD ROM ON PROFESSIONAL SERVICES

- CD ROM opens up new markets in the professional services arena, all of which rely on the availability of expert knowledge with the professional services vendors. The problem is that there are very few such vendors in the U.S. marketplace, and the acquisition of such talent will be a difficult process

since it will be in competition with manufacturers, software vendors, and turnkey systems vendors.

- There will be a small number of vendors who will make the CD ROM market a target for their services, driven by customer demand. INPUT expects the majority of the revenue, however, to be captured by new, small companies established with CD ROM as their only market.
- Therefore, although the CD ROM professional services revenue projections in Exhibit III-10 will seem small, they will appear attractive to the 30 or so new vendors expected in the marketplace by 1991. In comparison to the established professional services market of nearly \$32 billion in 1991, CD ROM services will have no visible impact.
- The largest CD ROM professional services market will be in the software development for the many large, customized CD ROM applications already emerging in the Fortune 50 companies. These are the target for most of the CD ROM players and require major systems redesign for maximum effectiveness. Battelle has already indicated its intent to pursue the CD ROM market. 3M Company has asked for help in producing a CD ROM-based product directory, specifically from software developers and "information designers" (how the information should be structured and presented).

EXHIBIT III-10

CD ROM's IMPACT ON PROFESSIONAL SERVICES

PROFESSIONAL SERVICES MARKET	\$ MILLIONS		
	1986	1991	AAGR
Non-CD ROM Markets	12543	31580	20%
CD ROM Markets			
Software Development	*	150	N/A
Consulting	*	45	N/A
Education	*	35	N/A
Facilities Management	*	12	N/A
Systems Integration	*	\$23	N/A
Total		\$265	N/A
Total New Market	\$12543	\$31845	21%

IV CD ROM APPLICATIONS MARKETS

IV CD ROM APPLICATIONS MARKETS

- In producing a forecast of CD ROM markets it was necessary to examine the many types of applications to which CD ROM can be applied and size each opportunity. This chapter provides a preliminary analysis of these vertical markets, with examples of products, services, and capabilities already being sold.

A. PUBLISHING/NEWS

- As of now, few publishers have made a move into CD ROM beyond a cursory examination, even though commercial products already exist (such as The Library Corp's BiblioFile Catalog Production Systems). This will rapidly change, and by 1991 INPUT expects a third of the entire U.S. publishing community to have at least one CD ROM product for sale.
- Publishing on CD ROM represents a dramatic challenge for today's publisher who is used to the end product(s) being stable (a book or other printed product whose format and content does not change). With CD ROM publications, the content may not change, but the retrieved format is a function of the user's need of the moment and the search/display parameters he defines. Thus, a CD ROM publication is not one end product, but a range of products.

- Because most major publishers have automated their publication process (and are familiar with the need to organize, index the data, and produce a "master" for publishing), the CD ROM process will not be an alien one. Also, the CD ROM disk itself can be viewed and treated like a book--a copy of a finite set of informational elements to be distributed to retailers. The difference lies in the initial need to find a way of simplifying CD ROM disk drives along with the early CD ROM disks because most end users will not have CD ROM drives.
- Given the flexibility provided by applications software, it is also theoretically possible to provide a single CD ROM disk that provides information to more than one application market. INPUT suggests that this would be unwise for early applications (an unnecessary complication) and best reserved for later marketing efforts when the technology and procedures have been fully absorbed.
- CD ROM will not impact current printed products, but will provide an additional delivery method for existing products and some new ones. The reason is that the printed word is familiar, convenient, portable, and cheap. Not only that, but initially the bulk of CD ROM publishing will be done for PC users (a small section of the publisher's market) who are willing to spend \$5,000 on hardware and software to access (albeit in new and exciting ways) a data base containing more information than they will ever use. What is more, this data base must be replaced periodically to remain current and the finished product (a page of display) is not as attractive or permanent as the printed page.
- The correct approach is therefore to concentrate early CD ROM products on markets which are not evolving rapidly and where the printed product is relatively stable in content. Dictionaries are a prime example. Not only is a CD ROM-based dictionary for general reference purposes possible, but fronted by the appropriate user interface/application software, specialist versions can be provided to narrow professions--a new range of products.

- Like most CD ROM markets, the first to emerge in the publisher arena have been CD ROM upgrades (on applications which duplicate on CD ROM what is already available in printed form). Exhibit IV-1 shows that while this will certainly be the largest market to begin with, new CD ROM products and multimedia products will soon emerge.
- The distinction between CD ROM upgrades and new CD ROM products is that the upgrades have no fundamentally new capabilities beyond presenting published data on CD ROM with basic access menus. New CD ROM products are designed around the powerful content-indexed characteristics of CD ROM and have end-user specific search/retrieval capabilities. Multimedia products are in a category by themselves and add a hitherto unavailable dimension to publishing (e.g., commented illustrations, verbal menu explanations, image search, etc., in addition to text/data indexing).

B. LIBRARIES

- As early as two years ago, prototype CD ROM products arrived at offering existing on-line or printed data bases. These products are slowly programming through the evaluation stage and will emerge on the market in force in the next three years. More significantly, a large number of publications are examining CD ROM as a means of cheaply distributing their product to U.S. libraries who themselves see CD ROM as an ideal storage/access media--one that allows repeated access, even browsing, of voluminous reference data for very low cost.
- The significant factors for libraries are twofold:
 - CD ROM cost parameters are the exact reverse of the on-line data bases that many libraries use (and even more would like to use if the cost were not so prohibitive). The more often you use the product, the

EXHIBIT IV-1

CD ROM PUBLISHING/NEWS MARKET, 1986-1991

CATEGORY	\$ MILLIONS		PERCENT
	1986	1991	
CD ROM Upgrades	\$3	\$260	144%
New CD ROM Services/Products	-	180	N/A
Multimedia Services/Products	-	80	N/A
Totals	\$3	\$520	180%

cheaper the per-use cost becomes, and, in any case, the total usage cost has a fixed value.

- The more publications that publish their bibliographic data bases on CD ROM, the greater the variety of usable material becomes, making having a CD ROM reader in the library a must.
- The key to such a widespread use of library reference materials on CD ROM is the availability (and broad adoption by publishers) of a standard storage format, CD ROM interface, and, most important of all, standard access/retrieval software. Such a goal is already being targeted by the National Foundation Standards Organization which has involved library service agencies as well as CD ROM vendors.
- A large number of practical products are already being offered on the market (with limited sales at present due to the initial stumbling block of users not having a CD ROM drive and having to buy one).
 - The Library Corporation's "Bibliophile" product carries all Library of Congress records covering frequently requested titles published since 1900. Annual subscriptions cost \$870 and provide a quarterly CD ROM disk update. The CD ROM drive hardware needed costs an additional \$3,000.
 - DEC offers several CD ROM products including COMPENDEX (Computerized Engineering Index) which provides abstracts of over 45,000 journals and conference proceedings priced at \$1,200 a volume.
 - Grolier will shortly make a version of the American Encyclopedia available on optical disks.
 - The British Library is developing a CD ROM-based of British Books in Print.

- The most extensive pilot project underway is that of the Cataloging Distribution Service of the Library of Congress. CD ROM disk candidates include Americana (on monographs on American literature), music (on monographs on music and sound recordings cataloged), name authorities (on personal, corporate, conference, and geographic names headings), and subject authorities (for subject headings). These can be expected by 1987.
- INPUT's expectations for the growth of the library market is given in Exhibit IV-2 for the usual three categories of products.

C. LEGAL

- The legal profession is, like few others, bound by precedent--the statutes and decisions of courts that go back to the earliest recordings have value in the judgements made today. Searching this enormous body of records is a necessary part of every lawyer's daily activities, as is making sure that the most recent data is available.
- Most of these searches are performed by hand and by attorneys' assistants. The on-line services that are available are not used as much as they might be because of cost and poor user interface with the systems. Borrowing, performed at length in manual searches, is avoided if the search is being performed on-line.
- In addition, the highly specialized nature of the legal profession makes it not one but dozens of different markets--a patent lawyer has totally different needs from those of a tax lawyer. This would ideally be resolved by having a separate, specific, user front end query capability attached to a general, indexed, search/data base management tool which searches a CD ROM containing a variety of reference files.

EXHIBIT IV-2

CD ROM LIBRARY MARKET, 1986-1991

CATEGORY	\$ MILLIONS		PERCENT AAGR
	1986	1991	
CD ROM Upgrades	-	\$50	N/A
New CD ROM Services/Products	\$1	75	37%
Multimedia Services/Products	-	20	N/A
Totals	\$1	\$145	171%

- The legal profession is one market where CD ROM is likely to have a significant impact on on-line data base services such as LEXIS and Westlaw (the two dominant U.S. legal services). However, depending on the subscription pricing used by the CD ROM supplier, the impact may be lessened. Furthermore, since the most capable and knowledgeable vendors in the field are those offering LEXIS, Mead Data Control, and Westlaw, the actual impact is largely within their control.
- Exhibit IV-3 provides INPUT estimates of the three main categories of legal markets.

D. MEDICAL

- Not unlike the legal profession, the medical profession has a constant need to access reference material and is equally specialized (if not more so). What is lacking in this market (like many other CD ROM potential markets) are a concise, machine-readable body of specialized data to support each of the very specific medical disciplines, and equally necessary, a user-specific front end interface to the body of data.
- Examples of the separate disciplines (each with its own usage environment) include obstetrics, therapeutics, posology, general medicine, research, and surgery. Each has a specific need and a specific body of desirable information to which access is sought.
- Typically, publishers have the upper hand in deciding how quickly CD ROM products will arrive on the market because they own the rights to much of the desirable data. Unfortunately, they are least likely to want to rush into CD ROM, because of either having products to defend (e.g., on-line service or printed products) or lacking the systems design/software expertise that is required.

EXHIBIT IV-3

CD ROM LEGAL SERVICES MARKET, 1986-1991

CATEGORY	MILLIONS		PERCENT
	1986	1991	
CD ROM Upgrades	-	-	N/A
New CD ROM Services/Products	0	\$90	N/A
Multimedia Services/Products	-	-	N/A
Totals	0	\$90	N/A

- The National Library of Medicine (NLM) has collected and indexed most significant medical publications over the past 15 years. The result--MEDLARS--has been used alternately to provide published indices (e.g., Index Medicus) or on-line access to subject headings. The NLM invited CD ROM publishers to participate in a pilot research project in 1985, and work is proceeding on a variety of levels.
- In Europe, Elsevier (a Dutch publisher) has a competing body of data and publishes similar medical indices (e.g., Excerpta Medica). The main differences are that Elsevier uses physicians to index the data (a significant advantage), and that the NLM is a government-sponsored body that makes its data available far more cheaply.
- More modest in scope but equally interesting are the Indentidex (capsule identification), Emergindex (critical care), Poisindex (poison identification), and Drugdex (drug data) data bases produced by Micromedex Inc. The company has hedged its bets by producing all of the above on microfiche, optical disk, and magnetic tape media.
- Exhibit IV-4 provides INPUT's estimates of the development of medical services on CD ROM.

E. SECURITIES/FINANCIAL

- The second largest CD ROM market is the securities/financial market, which has an equal appetite for up-to-the-minute on-line data and historic trend analysis. The two markets will co-exist, but most historic analysis data handling that is currently provided on-line will eventually go off-line to CD ROM.

EXHIBIT IV-4

CD ROM MEDICAL SERVICES MARKET, 1986-1991

CATEGORY	\$ MILLIONS		PERCENT AAGR
	1986	1991	
CD ROM Upgrades	-	60	N/A
New CD ROM Services/Products	-	\$70	N/A
Multimedia Services/Products	-	-	N/A
Total	0	\$130	N/A

- This should not be construed as CD ROM having an overall negative impact on RCS services in the market because INPUT expects that, in the long run, CD ROM analyses will encompass on-line search for the latest data (in the short-term there will be some impact, however).
- The most obvious target for CD ROM is the stock price/company analysis and trend data of services like Value-Line. CD ROM can accommodate the chart images, text, and new data (e.g., historic stock quotes, earnings per share, etc.) that are combined in such services. Already, Datext, in conjunction with Dow Jones, is offering a CD ROM data base of information on corporate America which offers a hybrid service combining on-line access subscription with CD ROM subscription in a single bundled price.
- The variety of securities/financial applications is enormous:
 - Money market instruments.
 - Stock quotations.
 - Commodities quotations.
 - Futures quotations.
 - Precious metals quotations.
 - Broker transaction histories (by client).
- Exhibit IV-5 summarizes INPUT's forecast for the three categories of CD ROM products and services.

EXHIBIT IV-5

CD ROM SECURITIES/FINANCIAL MARKET, 1986-1991

CATEGORY	\$ MILLIONS		PERCENT AAGR
	1986	1991	
CD ROM Upgrades	-	\$60	N/A
New CD ROM Services/Products	\$1	\$130	164%
Multimedia Services/Products	-	90	N/A
Total	\$1	\$280	209%

F. CREDIT

- To date, the credit information services market has been dominated by on-line services. The main categories of service are credit card verification, check guarantee/verification, consumer credit, and commercial credit. Most of these services provide transaction approval in real time, and this is unlikely to change.
- Historic analysis and trend analysis are less emphasized but would be very valuable. On-line service rates currently make such services prohibitively expensive, and this provides a window of opportunity to CD ROM. There is a real danger of on-line to off-line conversion, however.
- Fortunately, the owners of the data required to produce CD ROM service (D&B, TRW, Telecredit, etc.) are in the driver's seat as to how quickly credit services are made available on CD ROM and at what price.
- There are many potential targets for a CD ROM-based credit workstation (most likely PC-driven).
 - Less than 4% of retail check dollar volume is validated/guaranteed (\$470 billion value).
 - Less than 28% of credit card transactions receive credit authorization (\$300 billion value).
 - Large retailers (department stores, supermarkets, etc.) could benefit greatly from systematic card/check authorization; many offer their own credit cards and could easily provide the data base necessary for in-store CD ROM turnkey systems.

- The driving force will not be vendor infatuation with CD ROM technology but the explosion of fraud and bad credit losses. Credit card authorization volume is growing at 14% per annum, and the charges for transaction approval are in the 2-6% of dollar volume range. Financial institutions may see the possibility of extending authorization/approval services to all transactions while reducing costs by using in-store, in-house CD ROM-based workstations supported by a monthly CD ROM disk release.
- Exhibit IV-6 summarizes the expected growth of CD ROM markets through 1991.

G. DEMOGRAPHIC/RESOURCES

- Demographic/resources applications cover a broad spectrum of needs including:
 - Cartography.
 - Census data.
 - Urban planning.
 - Consumer income, preferences, employment.
 - Natural resources (gas, petroleum, coal, etc.)
 - Crop surveys and historical production.
- All of the above apply to U.S. and worldwide envelopes.

EXHIBIT IV-6

CD ROM CREDIT SERVICES MARKET, 1986-1991

CATEGORY	\$ MILLIONS		PERCENT AAGR
	1986	1991	
CD ROM Upgrades	-	-	N/A
New CD ROM Services/Products	-	\$105	N/A
Multimedia Services/Products	-	20	N/A
Total	0	\$125	N/A

- Enormous volumes of printed data support the above applications, and the use of on-line services or in-house turnkey systems is still limited. Most of these applications are ideal for CD ROM workstations since the periodicity of the data is long and the need for real time, up-to-the-minute data is low.
- The demand for such data is not high compared with other application groups, however, so INPUT's forecast for the growth of these markets (see Exhibit IV-7) is moderate.

H. REAL ESTATE

- Two types of real estate data bases exist:
 - Data bases containing textual and numeric information about residential property, industrial property, and commercial property. These are available through real estate agents and brokers and are sold, leased, or rented from information services vendors such as PRC Realty Systems.
 - Numeric data bases used for real estate/housing mortgage and financial instrument quoting and market analysis. These include the National Association of Home Builders "time" series on housing starts, building permits, and other housing variables for all counties in the U.S., and Chase/FDC's financial housing market variables data base.
- A variety of financial instrument data is also offered representing mortgage funding including Shelternet (First Boston Capital), Realtors National Mortgage Access, Loan Express (PRC), Loan Link (TRW), and the International Mortgage Exchange (Union Planters National Bank).
- The largest real estate opportunity for CD ROM is a multimedia data base containing house layout plans, images (front, rear, etc.), descriptive text, and

EXHIBIT IV-7

CD ROM DEMOGRAPHIC/RESOURCES MARKET, 1986-1991

CATEGORY	\$ MILLIONS		PERCENT AAGR
	1986	1991	
CD ROM Upgrades	-	\$5	N/A
New CD ROM Services/Products	-	\$50	N/A
Multimedia Services/Products	-	10	N/A
Totals	\$0	\$65	N/A

data on the property plus voice-over commentary. The potential for this is limited, however, by two factors:

- The cost of producing such a sales tool.
- The volatile nature of the data--houses come on and go off of the market faster than the CD ROM disk can currently be produced.
- INPUT therefore believes that the real estate market will have to wait at least two years for CD ROM production delays to decrease to the three-week range before the market will begin to move.
- Exhibit IV-8 provides INPUT's forecast of the CD ROM real estate market for the three categories of products and services.

I. ECONOMETRIC

- Econometric data bases primarily contain aggregate economic or financial data stored in time series with a frequency from weekly to annually. There are two types:
 - Historical, where data is collected and adjusted over a significant time period.
 - Forecast, which is predictive based on economic models of ranging sophistication, producing data that covers a time period varying from one week to ten years.
- Information services vendors sell these two services primarily to Fortune 50/500 companies and offer consulting services to interpret the on-line data base services. The audience is usually the chief economist of industry, banks,

EXHIBIT IV-8

CD ROM REAL ESTATE MARKET, 1986-1991

CATEGORY	\$ MILLION		PERCENT
	1986	1991	
CD ROM Upgrades	-	\$10	N/A
New CD ROM Services/Products	-	70	N/A
Multimedia Services/Products	-	40	N/A
Totals	\$0	\$120	N/A

insurance companies, mortgage houses, etc. Over 60 such data bases are in use.

- Clearly, the opportunity for CD ROM is in the historical data base side of the business, but INPUT believes that hybrid services (a combination of on-line service with off-line CD ROM service) would be the most appropriate. INPUT also believes that unrestricted use of CD ROM historical data bases will accelerate the use of on-line forecasting.
- The market is nevertheless relatively small and specialized--a typical CD ROM market--and is not expected to take off before 1988. Exhibit IV-9 summarizes the market growth to 1991 for the three types of service and products.

J. EDUCATION

- Education is one of the most exciting and interesting CD ROM markets for many reasons:
 - State and federal funds (as well as a huge private fund pool) are available for new products and services, particularly those that can have a demonstrable benefit.
 - A number of university-based and academic CD ROM projects are already either in evaluation stages or under way. The education sector's involvement with CD ROM has already begun.
 - Education is the prime test bed for all kinds of new information processing technologies (witness timesharing, minicomputers, and PCs in their time), and CD ROM will be no exception.

EXHIBIT IV-9

CD ROM ECONOMETRIC MARKET, 1986-1991

CATEGORY	\$ MILLION		PERCENT AAGR
	1986	1991	
CD ROM Upgrades	-	\$50	N/A
New CD ROM Services/Products	-	20	N/A
Multimedia Services/Products	-	-	N/A
Totals	\$0	\$70	N/A

- Several CD ROM vendors are already targeting education (and INPUT believes IBM will also do so shortly).
- Exhibit IV-10 summarizes INPUT's expectations for the education market over the 1986-1991 forecast period.

K. OTHER MARKETS

- There are many interesting markets that fall into this category.
 - Marketing data bases--highly motivated data bases of consumer buying habits such as A.C. Nielsen, Telmar Media, and Information Resources.
 - Travel data bases (which would benefit from the multimedia capabilities of CD ROM).
 - Personnel data bases (particularly personnel search), including military records, career details, etc.
 - Space data (already using CD ROM for the analysis of data from the Jupiter probe).
- In each case the decision must be made of whether the adoption of CD ROM is for a meaningful market or for personal use only. This is not to say that personal use CD ROMs will not be an interesting market; on the contrary, if data disks are made available in sufficient variety and scope, personal CD ROM use could easily outstrip professional market use.
- The likelihood at present is that personal use CD ROMs will be restricted by the lack of software and hardware standards which would allow broad access to a library of data disks, so that unlike the PC market, the professional markets will dominate in the early stages of CD ROM development.

EXHIBIT IV-10

CD ROM EDUCATION MARKET, 1986-1991

CATEGORY	\$ MILLION		PERCENT AAGR
	1986	1991	
CD ROM Upgrades	-	\$15	N/A
New CD ROM Services/Products	-	45	N/A
Multimedia Services/Products	-	60	N/A
Totals	\$0	\$120	N/A

V STRATEGIC RECOMMENDATIONS

V STRATEGIC RECOMMENDATIONS

- CD ROM is a significant opportunity, but one that requires exceptionally careful preparation to exploit. This section examines the eight fundamental planning steps that must be executed in order to avoid pitfalls.

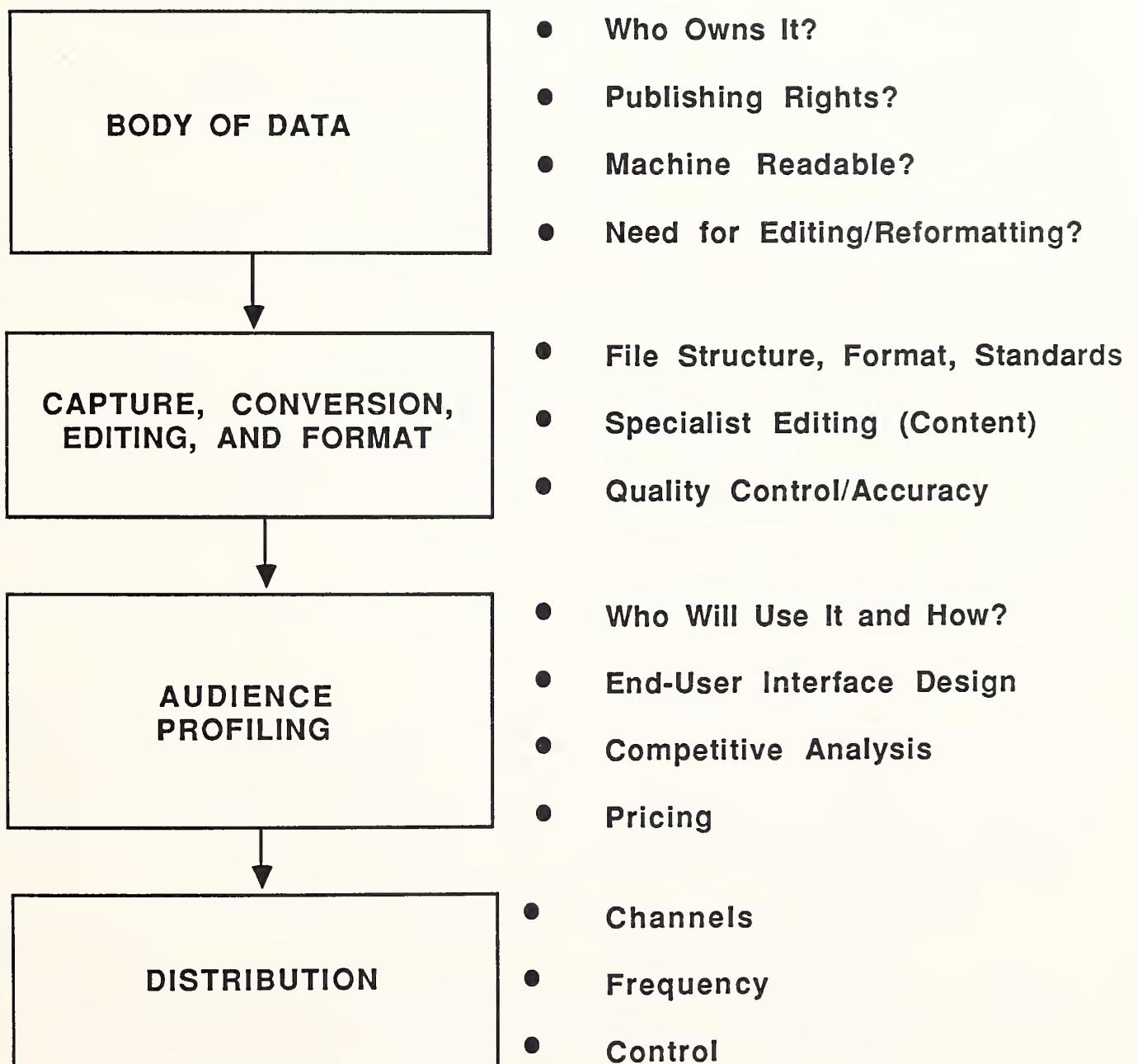
A. OPPORTUNITY ANALYSIS

- Planning for a CD ROM market entry begins with opportunity analysis which is a complicated, multidisciplinary process. First, since CD ROM deals with the channeling of a body of data to an end-user audience, the characteristics of the data itself must be determined.
 - The ownership of the data is important (and if it is a single source or multiple source); government data is an excellent source of CD ROM applications due to its public nature.
 - Are there publishing rights, copyrights, or any other restrictions that might apply to the marketing of that data on a CD ROM?
 - Is the data in machine readable form? If not, it may be impractical to consider using it at all since keyboarding may be prohibitively expensive.

- If the above factors can be resolved, will there be a need for substantial editing and reformatting of the data for specialist use (usually a single, very narrow market will be targeted).
- Assuming all of the above can be resolved, a number of key questions need to be considered, including the choice of the structure of the CD ROM file, the CD ROM standard that will be used (there are several competing standards at present), the source of specialist editing that will be required to validate the content of the data file, and how quality control will be accomplished.
- Audience profiling is next, with a heavy marketing emphasis. At this stage, the exact nature of the end user must be known not only in terms of the kind of information that is required, but also in terms of the way(s) in which the information will be queried, the thought process(es) that are likely (wayfinding), and the terms that will be used (vocabulary). This is essential for the design of the end-user interface and will also impact the competitive analysis and, to some extent, service pricing.
- Pricing is a key factor, of course, and is linked to the distribution process.
 - How will the product reach the market, and how are the intermediaries compensated?
 - What is the update frequency of the data? How vital is the need for these updates?
 - How can the distribution be controlled?
- Exhibit V-1 summarizes the whole process.

EXHIBIT V-1

OPPORTUNITY ANALYSIS



B. INFORMATION SERVICE/PRODUCT DEVELOPMENT

- Most information services vendors are at a serious disadvantage when considering the development of CD ROM services or products. They have little or no in-house knowledge of or capability in the technology. Even those who do (e.g., MicroPro) may choose to delay entering CD ROM markets for another reason--standards have not been established firmly enough to make product development investment safe.
- There are other reasons which will cause information services vendors to hesitate about implementing CD ROM.
 - Self impact will be a prime consideration of on-line data base vendors; whether this fear is justified or not, many RCS vendors will be in no rush to find out.
 - The market is totally undeveloped and will suffer initially from a familiar difficulty: a lack of installed CD ROM drives capable of reading the product that the information services vendor wishes to sell. Turnkey system vendors will be the least impacted by this shortcoming, of course, but software vendors and data publishers will be heavily impacted.
 - IBM has not declared itself yet. Many information services vendors will remember the personal computer market in its early stages when it looked as though choosing Apple or Commodore would ensure them a mainstream market (only to find IBM taking over the market in two short years).
 - Application knowledge will be fundamental in implementing a successful CD ROM service or product; while information services vendors have detailed experience, even expertise, in a handful of

applications, many are not used to focusing an entire marketing plan around a single, narrow application in an untried technology.

- However, despite all of the reservations that information services vendors will have about implementing CD ROM services or products quickly, they will find themselves forced to hurry the pace by the speed of the market's development. In a manner similar to the early PC software market, CD ROM is already benefiting from new companies entering the market which are entirely focused on CD ROM opportunities. As these newcomers progress and grow, their success will excite the appetite of established software, turnkey, and RCS vendors, particularly when they find themselves losing business.
- INPUT therefore expects 1986 and 1987 to be quiet years in terms of CD ROM market development, during which time startups will establish themselves and begin market penetration. By 1988, established vendors will enter the market in force, and by 1989 the CD ROM market development will be in its takeoff phase.

C. FOCUS ON APPLICATION KNOWLEDGE

- To a degree unlike that found in most information services markets, CD ROM will require extremely detailed knowledge of the application targeted.
 - The sourcing, capture, and update frequency of the data/information offered will be a prime consideration since CD ROM master disk production is not cheap. In a way, CD ROM is a batch process, and determining which time periodicity makes the most sense to the target audience without being overly expensive is not an easy decision.
 - CD ROM offers hitherto unheard of options such as voice-over commentary of images, charts, or access menus. No one has a great

deal of experience in this field, but the possibilities are intriguing. Most likely, however, the early CD ROM products and services will be "single media."

- It is not enough to understand the application and the data that supports it; it is vital to be able to foresee the thought process of the professional user and tailor the access options to that thought process. In most instances, this will require involving professional help at all stages of product/service design and extensive prototype testing.

D. DISTRIBUTION CHANNELS: KEY TO MARKET ACCESS

- Having the product or service and selling it successfully are, of course, two different things. CD ROM is unusual in that it converts a set of data frozen in time into a commodity. Distributing that commodity will often require accessing established distribution channels that are used for some other product (e.g., paper, COM, etc.) and also setting up channels where none exist.
- In the early stages of the CD ROM market, the absence of an installed reader (drive) will hamper sales because required user investment in hardware will be significant and in most cases more expensive than the CD ROM service/product itself.
- Because of the need to access a very large base very quickly, success in CD ROM markets will require the establishment of high volume distribution channels. This in turn means partnership with institutions, associations, publishers, and very large accounts. For the most part, such partnerships are open today, but information services vendors should quickly determine who the key players are in the applications markets they will target and begin overtures immediately. Once again, in a replay of the PC market's development, there will be a rush to capture dealer/distributor channels early in the

market's development. Also, INPUT expects telemarketing and direct sales campaigns to play a significant role in the sale of data disks and turnkey systems respectively.

E. INFORMATION SERVICES PRODUCT LIFE CYCLE PLAN

- Information services vendors must expect CD ROM services and products to have relatively short life cycles.
 - Data/information disk life cycles will be typically three months to one year.
 - Software products' life cycles will be typically two years.
 - Turnkey system life cycles can be expected not to exceed three years.
- Complicating the issue are the multivendor possibilities of CD ROM which are a Pandora's box of capabilities and functions that information services vendors are unused to handling. Most likely, initial products and services will be defensive in nature; i.e., designed to satisfy basic information access needs with few frills or options--it is cheaper to enter the market this way and self-impact is lessened. The net result of this cautious approach will be to reduce service/product life cycles, further by making initial CD ROM services and products easy targets for the competition.
- This can turn out to be a vicious circle. Information services vendors fear that the CD ROM market targeted will be small so they spend little money on early products, which consequently have only rudimentary capabilities. This makes the product/service less attractive to end users and easy prey for competition. Sales suffer, and the information services vendor sees his fears confirmed.

- CD ROM markets will require a planned series of "mid-life kickers" or enhancements that regularly update the capabilities and functions of the early products and services in a smooth upgrade path. In this way, basic product life cycles will be extended and profitability enhanced.

F. MINIMIZING SELF-IMPACT/MAXIMIZING COMPETITIVE IMPACT

- The information services vendor must walk a fine line between minimizing self-impact with CD ROM products and services while maximizing the impact on the competition. To do that he must choose an application that, while remaining within his overall zone of competence, extends beyond current services or at least enhances them.
- INPUT believes that the CD ROM impact fear is largely unfounded. The same kind of concern was apparent when publishers began offering on-line services. Their concern was that on-line services would reduce sales of print products. In general, this has not happened (in fact, in some cases print sales have gone up as on-line users--generally new users--have taken print subscriptions to supplement their on-line searches).
- However, there is no doubt that such an impact is likely if the on-line publisher is not the prime publisher, or if the CD ROM publisher is not the on-line or print publisher. The reason is that the on-line or print publisher is unable to influence the product profile, performance, pricing, or introduction timing. Therefore it is necessary for on-line and print publishers (if they wish to control self-impact) to produce CD ROM products of their own, serving their own markets and applications. Not only will this serve to defend their users against predators (while users are considering their current vendors' CD ROM products, they will be less likely to succumb to competitors), but it will also allow first-hand experience of CD ROM products and services, enhancing understanding of opportunities. Either way, CD ROM cannot be ignored.

G. MULTIMEDIA CAPABILITIES

- The most explosive opportunity that CD ROM offers is that of multimedia services, where audio, image, text, and data can coexist on the same storage media and benefit from the same search/recall menu options. There is no established expertise in handling these capabilities, and they must be created in parallel with the products that will use them.
- In all probability, few CD ROM products and services will integrate all four capabilities, but two at a time seems highly likely on the early years.
 - Images with text and/or data.
 - Images with sound-over commentary.
 - Menu options with comments.
- The most logical application for multimedia capabilities is education tools where menu choices lead to images which have voice-over commentary. This is likely to be IBM's first foray into the CD ROM market, but this market must wait for the development of a whole new array of capabilities in systems design. Fortunately, CD ROM does not need multimedia capabilities to succeed in the marketplace, but will happily compete with ordinary magnetic storage, paper files, COM files, and on-line storage services and products.

APPENDIX A: FORECAST DATA BASE

APPENDIX A: FORECAST DATA BASE

- The following forecasts, shown in Exhibits A-1 and A-2, provide year-by-year data on the size and growth of the CD ROM market divided into:
 - CD ROM information services markets by delivery mode.
 - CD ROM information services markets by application.

EXHIBIT A-1

CD ROM MARKETS BY DELIVERY MODE

DELIVERY MODE	1986	1987	1988	1989	1990	1991	AAGR
Processing/Network Services	1	5	17	54	210	650	265%
Software Products	0	3	12	39	120	470	N/A
Turnkey Systems	2	8	24	80	265	825	233%
Professional Services	0	1	3	14	32	155	N/A
Total	3	17	56	187	627	2100	271%

EXHIBIT A-2

CD ROM MARKETS BY MAJOR APPLICATIONS

	1986	1987	1988	1989	1990	1991	AAGR
Publishing/News	3	8	21	67	230	520	180%
Libraries	1	2	4	10	65	145	171%
Legal	0	0	1	4	19	90	N/A
Medical	0	1	4	14	40	130	N/A
Securities/Financial	1	4	12	40	95	280	209%
Credit	0	1	5	13	35	125	N/A
Demographic/Resouces	0	0	1	3	15	65	N/A
Real Estate	0	0	2	10	38	120	N/A
Econometric	0	0	1	8	26	70	N/A
Education	0	1	3	9	30	120	N/A
Other	0	0	2	9	34	435	N/A
Total	5	17	56	187	627	2100	235%

APPENDIX B: USER SURVEY

APPENDIX B: USER SURVEY

- Exhibits B-1 and B-2 summarize the user responses to two specific questions concerning CD ROM.
 - How will CD ROM and other optical storage devices affect the user's use of on-line data base services?
 - When will the user start to implement CD ROM/optical storage in the marketplace?
- The total sample in this survey was 120 companies, 87 of which provided useful data.

CD ROM IMPACT ON ON-LINE SERVICES

Q. How will optional disk usage affect your on-line data base usage?

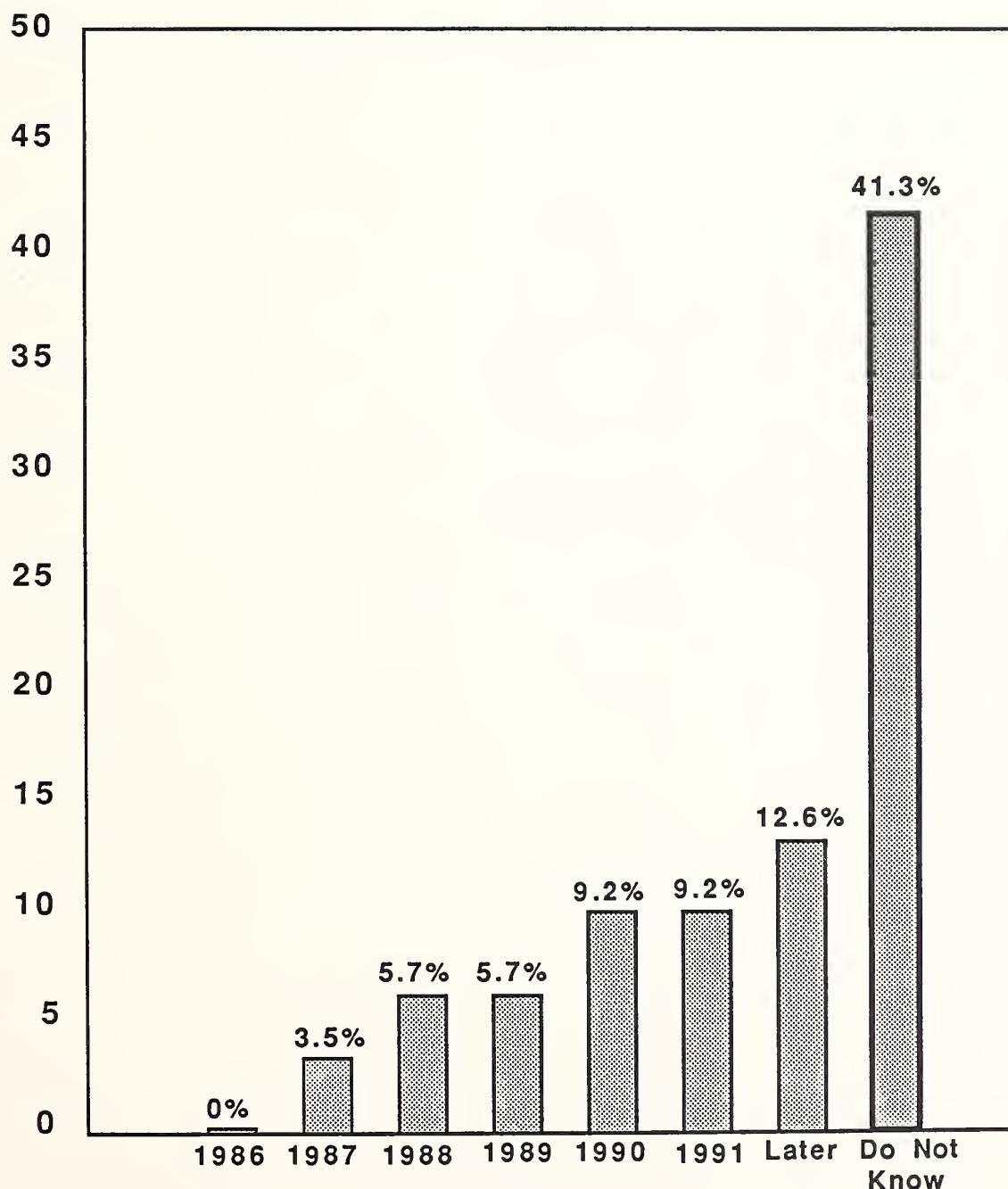
ANSWERS

- Will replace it (2)
- If it is cost effective, impact will be high (3)
- Will cause an increase in usage (9)
- No effect (13)
- Too soon to tell (34)

Total Sample: 87 companies

EXHIBIT B-2

USER PLANS FOR OPTICAL DISK STORAGE



Total Sample: 87 Companies

